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Monte Carlo Study of the Critical Phenomena in the Double Exchange Systems

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Critical phenomena of the double exchange model is studied using Monte Carlo method. Introduced as a model for ferromagnetism of colossal magnetoresistance manganites, it has been studied extensively for a long period. However, due to its strongly correlated nature, many fundamental aspects have just been discovered recently, and many others have not yet been clarified. Especially, it has been quite difficult to take into account effects of critical spin fluctuations in a controlled manner. An improved Monte Carlo technique developed by the present Authors made it possible to calculate the model at finite size clusters which are large enough to obtain thermodynamic limits. Here we show the numerical results for the critical phenomena of the double exchange model, which is fundamental and challenging subject to this model. Using finite-size scaling analysis as well as the Binder parameter plots, Curie temperature ($T_{\rm c}$) and critical exponents are estimated accurately. We discuss: 1) $T_{\rm c}$ is substantially decreased from its mean-field estimate, which makes the model to explain the experimental values consistently. 2) Critical exponents are consistent with estimates from the neutron scattering measurements. These are inconsistent with d.c. and r.f. magnetization measurements which exhibit mean-field like exponents. 3) To the best of our knowledge, this is the first time that critical exponents of a metallic system in the strong coupling limit is precisely estimated.